APPENDIX 1

1. Responses of DIP-PCB assembly mounted on plastic spacers due to sine sweep tests.

Figure A1.1 PCB response due to 1G input

Figure A1.2 PCB response due to 2G input
Figure A1.3 PCB response due to 3G input

2. Transmissibility plots of the DIP-PCB assembly mounted on plastic spacers due to sine sweep tests.

Figure A1.4 PCB transmissibility due to 1G input
Figure A1.5 PCB transmissibility due to 2G input

Figure A1.6 PCB transmissibility due to 3G input
3. Responses of DIP-PCB assembly mounted on rubber spacers due to sine sweep tests

Figure A1.7 PCB response due to 1G input

Figure A1.8 PCB response due to 2G input
Figure A1.9 PCB response due to 3G input

4. Transmissibility plots of the DIP-PCB assembly mounted on rubber spacers due to sine sweep tests

Figure A1.10 PCB transmissibility due to 1G input
Figure A1.11 PCB transmissibility due to 2G input

Figure A1.12 PCB transmissibility due to 3G input
5. Calculation of Damping Ratio (for $G_{in} = 1G$) for the DIP-PCB assembly mounted on:

a. Plastic Spacers

- Inner diameter = 3.5 mm
- Outer diameter = 6 mm
- Height = 14 mm

$G_{fn} = 25$ (peak $G_{out}$)

$$\Delta G_{fn} = \frac{G_{fn}}{\sqrt{2}} = \frac{25}{\sqrt{2}} = 17.67$$

$\Delta f = 2.4$

$f_n = 46$ Hz

$$\zeta = \frac{\Delta f}{2 \times f_n} = \frac{2.4}{2 \times 46} = 0.026$$

Figure A1.13 Response of the PCB mounted on plastic spacers

b. Rubber Spacers

- Inner diameter = 3.5 mm
- Outer diameter = 10 mm
- Height = 14 mm

$G_{fn} = 18$ (peak $G_{out}$)

$$\Delta G_{fn} = \frac{G_{fn}}{\sqrt{2}} = \frac{18}{\sqrt{2}} = 12.73$$

$\Delta f = 3.5$

$f_n = 46$ Hz

$$\zeta = \frac{\Delta f}{2 \times f_n} = \frac{3.5}{2 \times 46} = 0.038$$

Figure A1.14 Response of the PCB mounted on rubber spacers
c. Rubber Pads

Size of rubber pad: 300 mm x 20 mm x 12 mm

\[ G_{fn} = 18 \text{ (peak } G_{out}) \]

\[ \Delta Gf_n = \frac{G_{fn}}{\sqrt{2}} = \frac{18}{\sqrt{2}} = 12.73 \]

\[ \Delta f = 8 \]

\[ f_n = 90 \text{ Hz} \]

\[ \zeta = \frac{\Delta f}{2 \cdot f_n} = \frac{8}{2 \cdot 90} = 0.044 \]

Figure A1.15 Response of the PCB mounted on rubber pads
6. ANSYS simulation results when PCB is mounted on plastic spacers (2G input)

Figure A1.16 Displacement plot (2G input-plastic spacer)

Figure A1.17 Von-Mises stress plot (2G input-plastic spacer)
7. ANSYS simulation results when PCB is mounted on plastic spacers (3G input)

Figure A1.18 Displacement plot (3G input-plastic spacer)

Figure A1.19 Von-mises stress plot (3G input-plastic spacer)
8. Display window of the Sinusoidal vibration control software (at 1G input)

Figure A1.20 Sine sweep test at 1G input acceleration
APPENDIX 2

1. Sine Sweep Tests with PSOP-PCB assembly mounted on Plastic Spacers

![Figure A2.1 PCB response due to 0.75G input](image1)

Figure A2.1 PCB response due to 0.75G input

![Figure A2.2 PCB transmissibility due to 0.75G input](image2)

Figure A2.2 PCB transmissibility due to 0.75G input
Figure A2.3 PCB response due to 1G input

Figure A2.4 PCB transmissibility due to 1G input
2. Mechanical Shock Tests with PSOP-PCB assembly mounted on Plastic Spacers

Figure A2.5 PCB response due to 25G input

Figure A2.6 PCB response due to 30G input
3. Mechanical shock tests with PSOP-PCB assembly mounted on Rubber Spacers

**Figure A2.7** PCB response due to 25G input

**Figure A2.8** PCB response due to 30G input
4. Mechanical shock tests with PSOP-PCB assembly mounted on Rubber Pads

Figure A2.9 PCB response due to 25G input

Figure A2.10 PCB response due to 30G input
APPENDIX 3

1. Properties of Neoprene rubber

   Hardness*       60 (Shore A)
   Density*        1020 kg/m³
   Young’s Modulus* 1.05 MPa
   Loss factor#    0.25
   Temperature range -19°C to 99°C

2. Shape factor (S)#

   The shape factor, or bulge factor defined as the ratio of the area under the load and area free to bulge.

   \[ S = \frac{\text{Area under load}}{\text{Area free to bulge}} \]

3. Dynamic modulus of neoprene#

   For disk shaped isolator:
   \[ E_{\text{corrected}} = E (1+S^2) \]

4. Stiffness (k) of isolator#

   For disk shaped isolator:
   \[ k = \frac{E_{\text{corrected}}}{\varepsilon} \]
   where, ‘a’ is the disk radius, and ‘t’ is thickness of the disk.